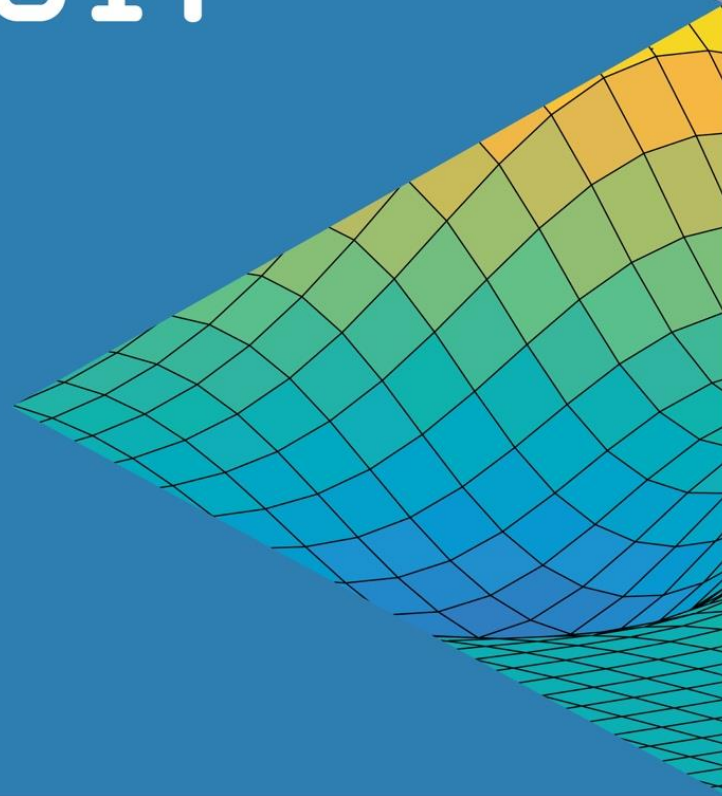# MATLAB EXPO 2017

Simulink as Your Enterprise Simulation Platform
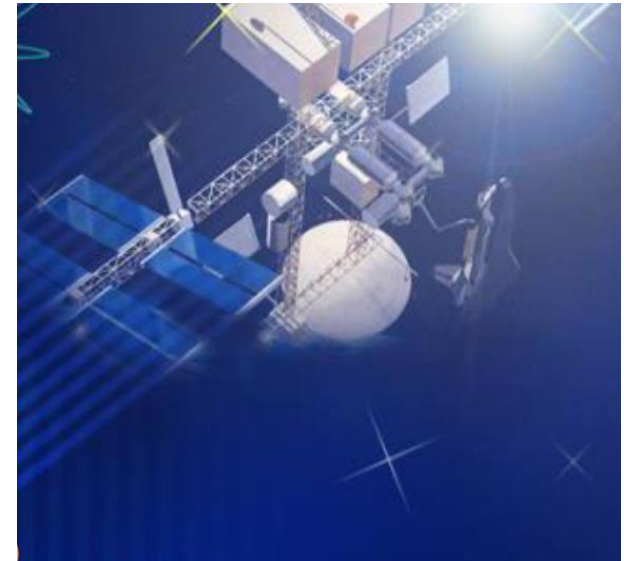
Dr. Mohamed Anas

Simulink as an Enterprise Simulation Platform

Simulating Spacecraft Communications for Deep-Space Missions

Dr. Deepak Mishra, Scientist/Engineer (SF)

Indian Space Research Organization

Challenge

- Integrating large multi-faceted project
- Simulation at multiple stages and in multiple domains to explore the problem
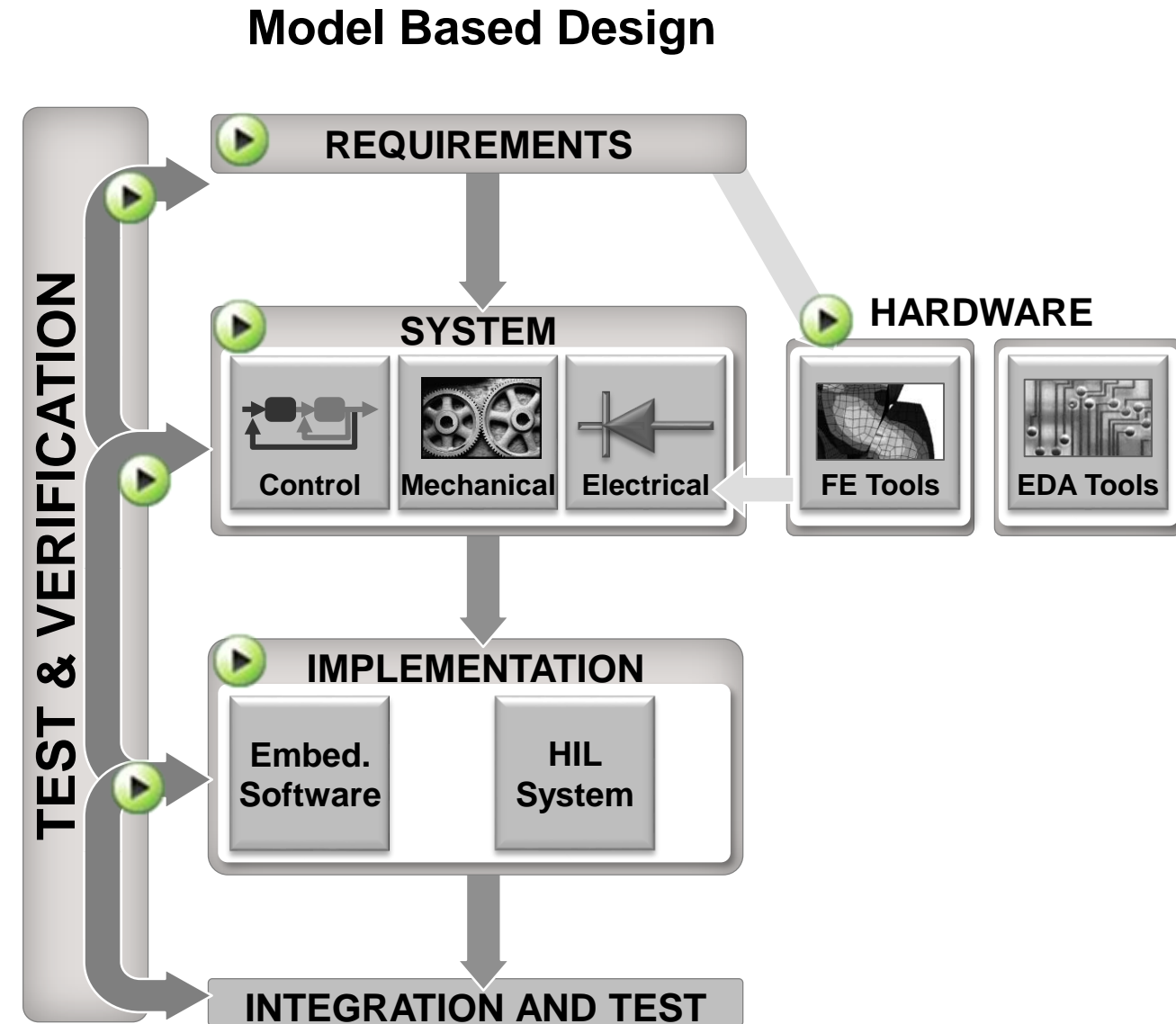
Solution

- Leverage Simulink as a platform
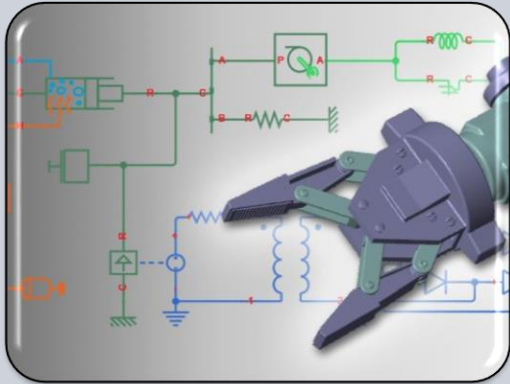
Enterprise Simulation Platform

- Enterprise - Any size business or project

- Simulation – Evaluating system behavior through computation

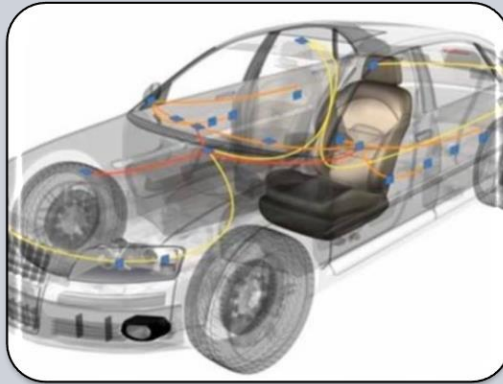- Platform – Scalable environment for multi-disciplinary collaboration

  ▶ **Simulation**
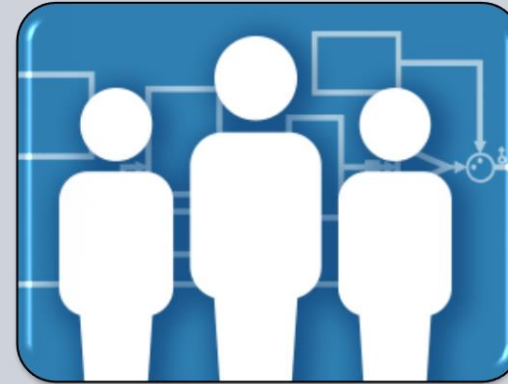
Model Based Design

Enterprise Simulation Platform Enablers

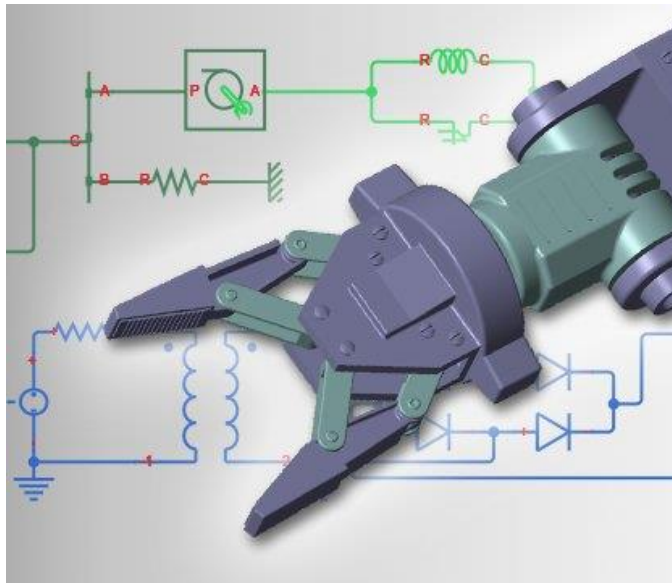Multi-Domain Modeling

Integration

Scalability

Multi-Domain Modeling

Multi-Domain Modeling in Simulink
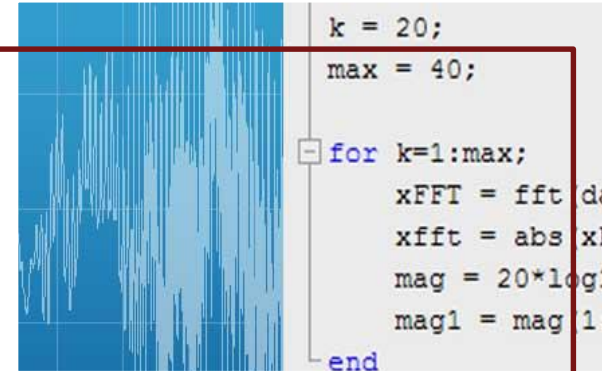

Dynamic Systems
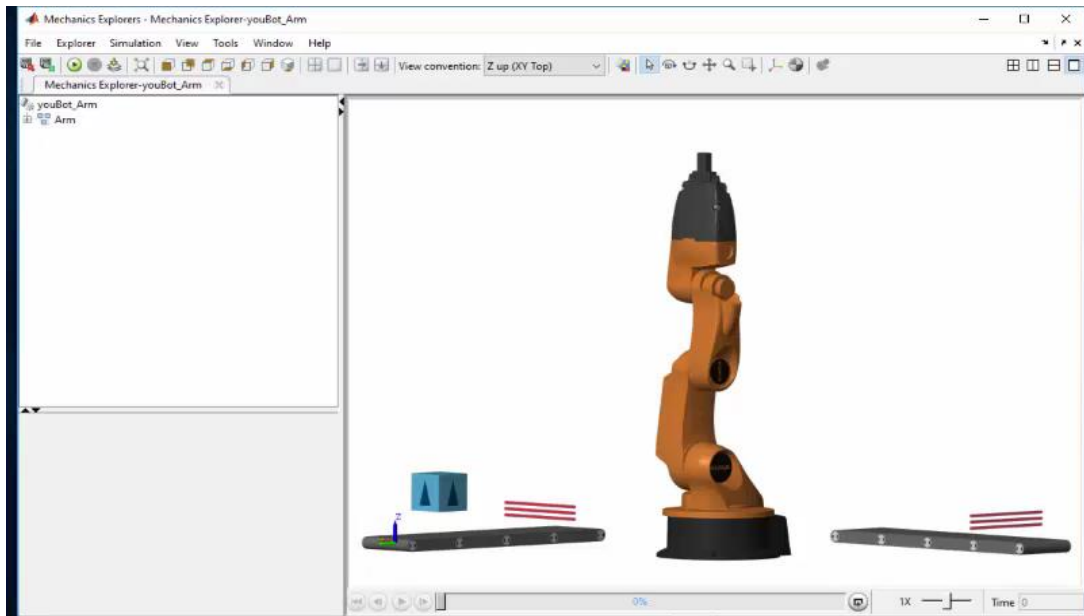

State Machines
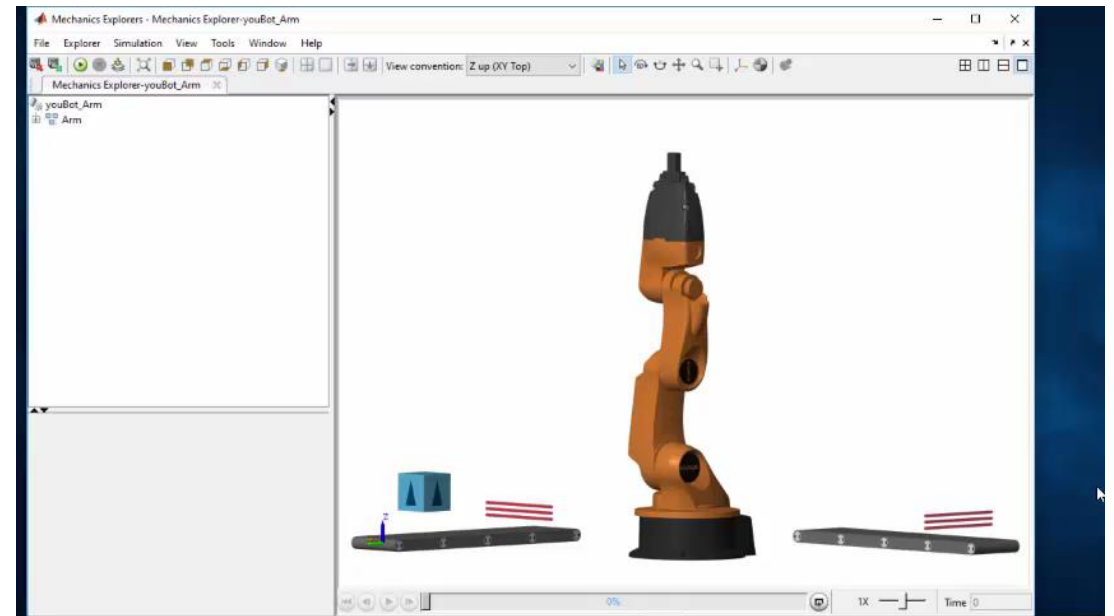

Discrete-Event Systems

Physical Modeling

Object-Oriented

Robot Arm Multi-Domain Simulation
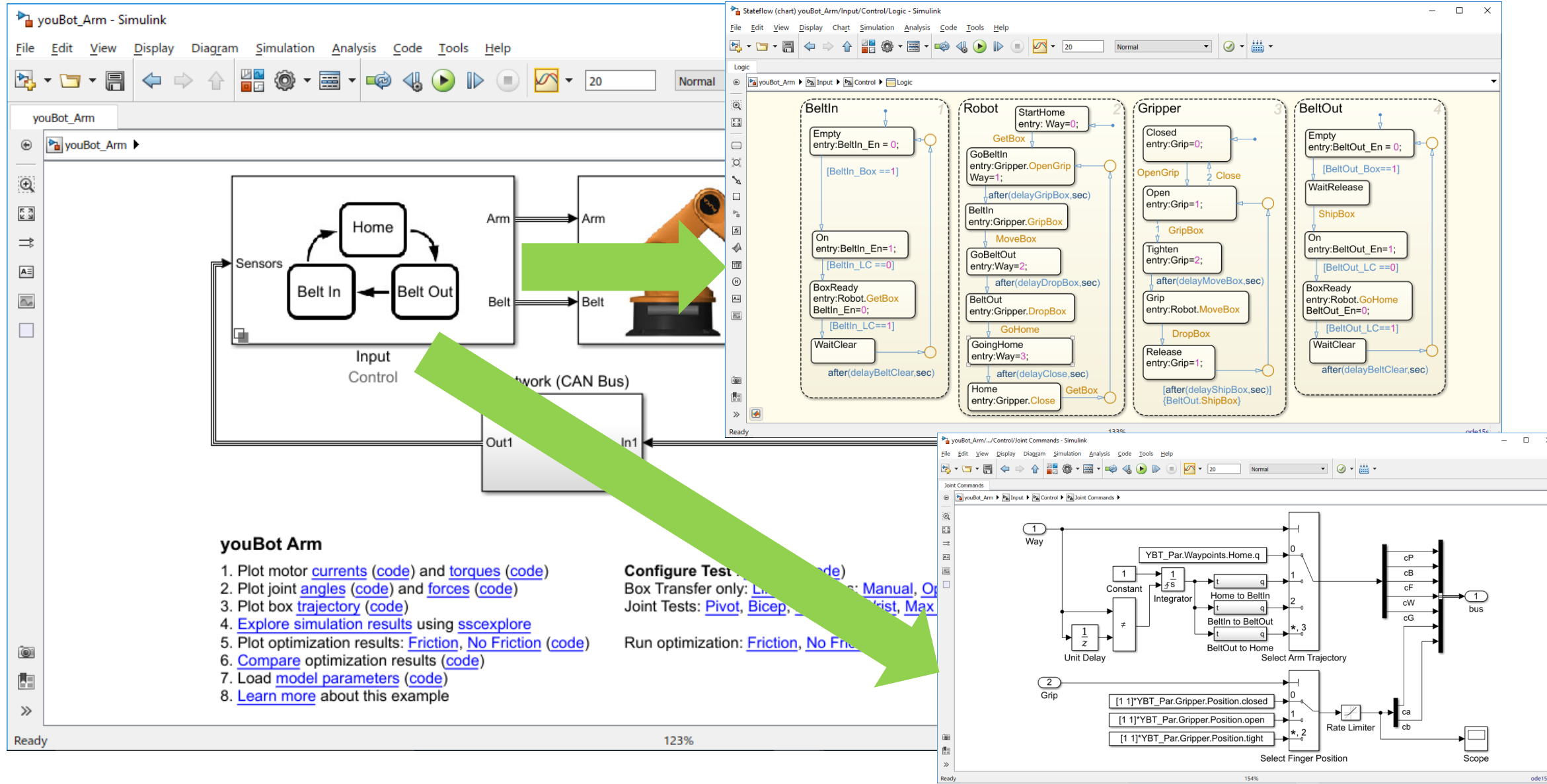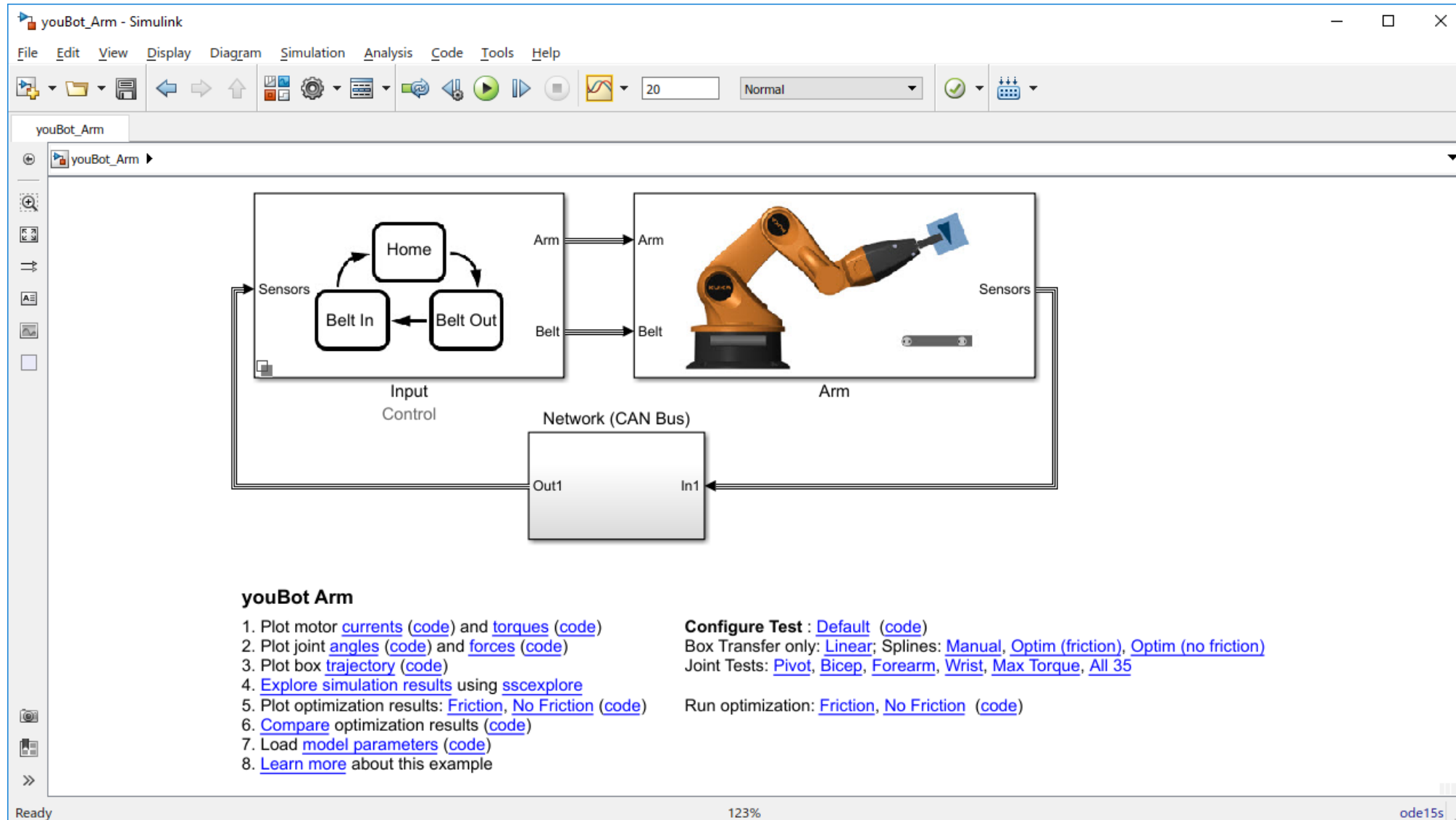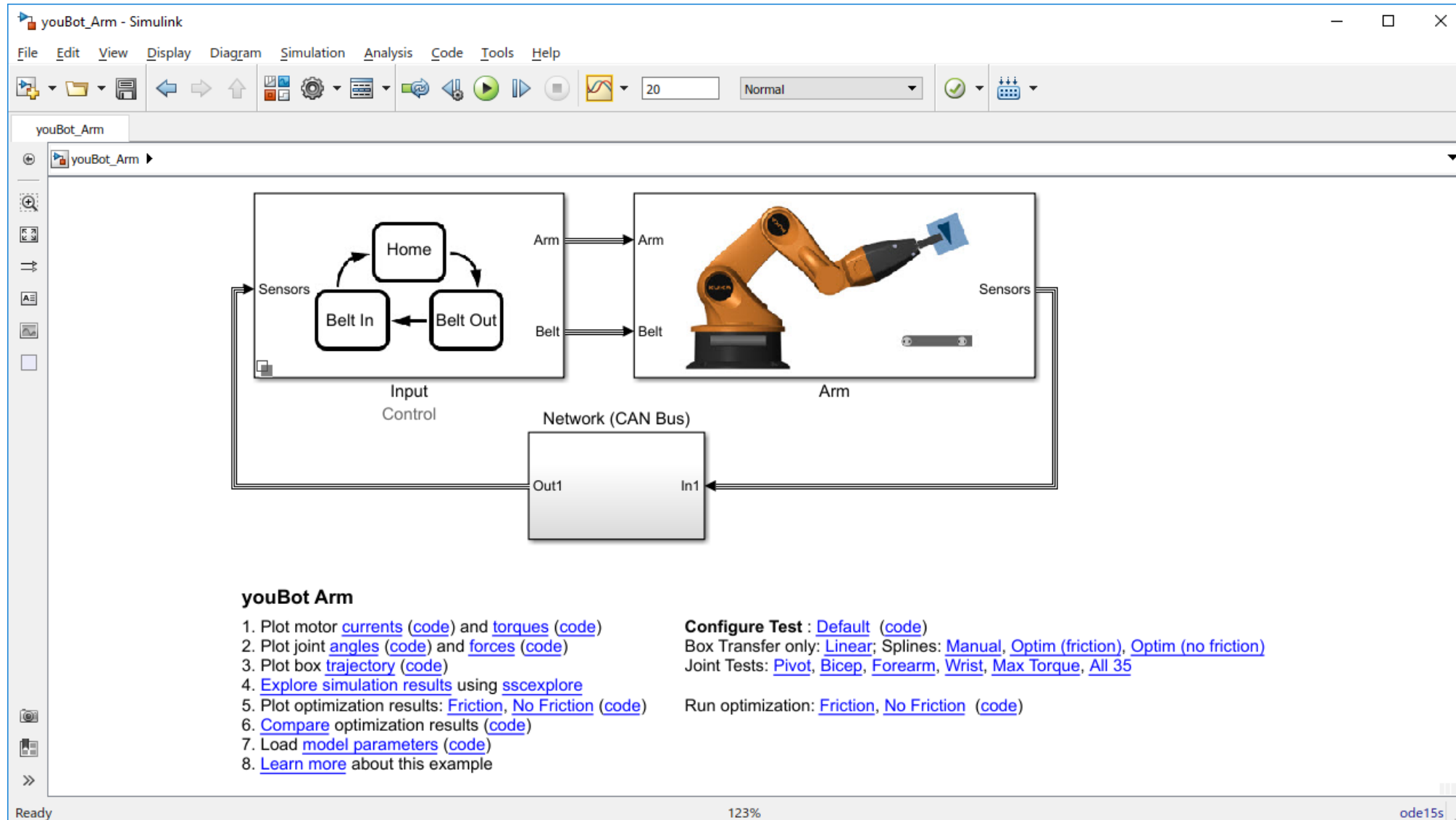
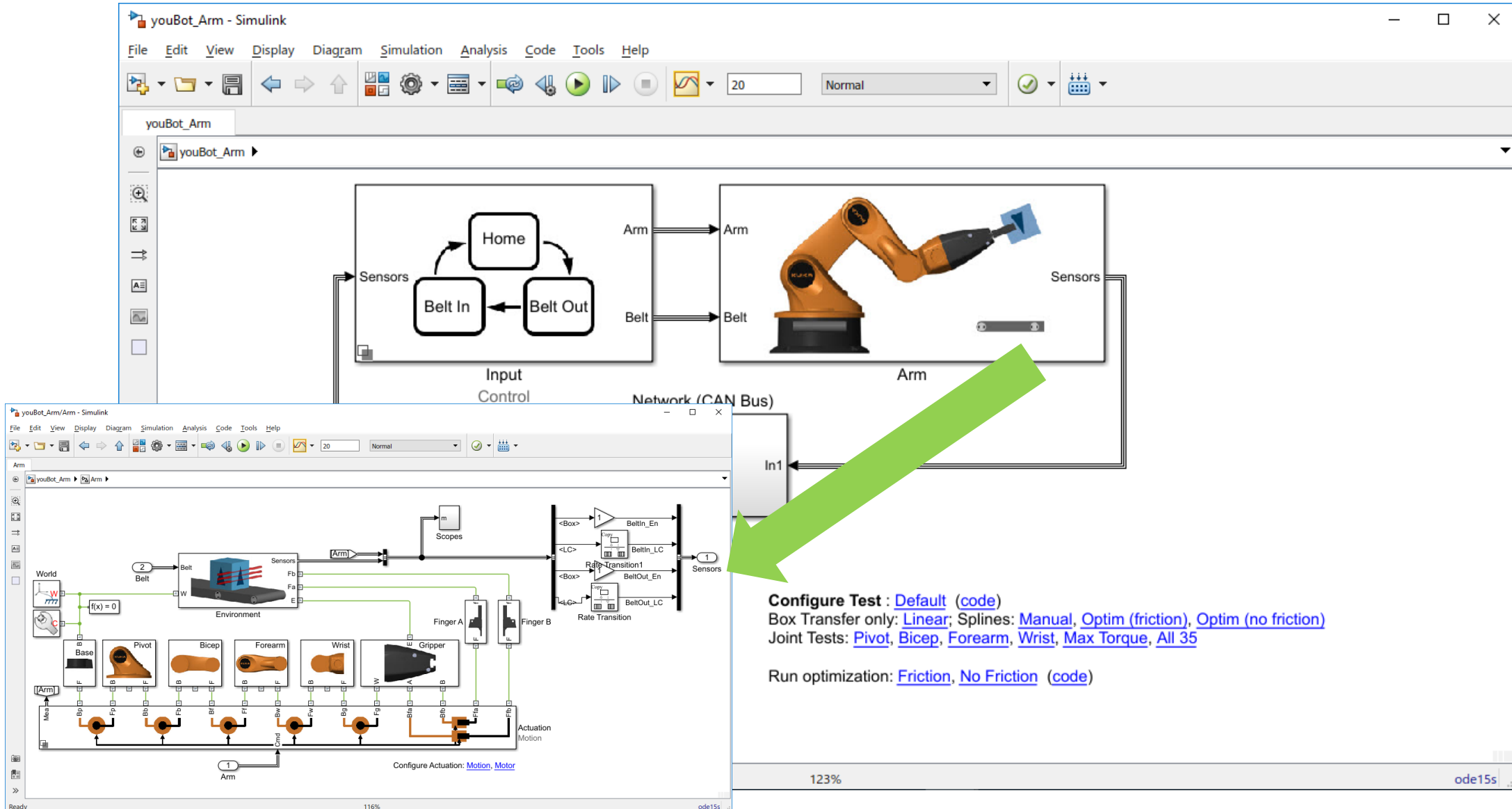Without Network Model

With Network Model

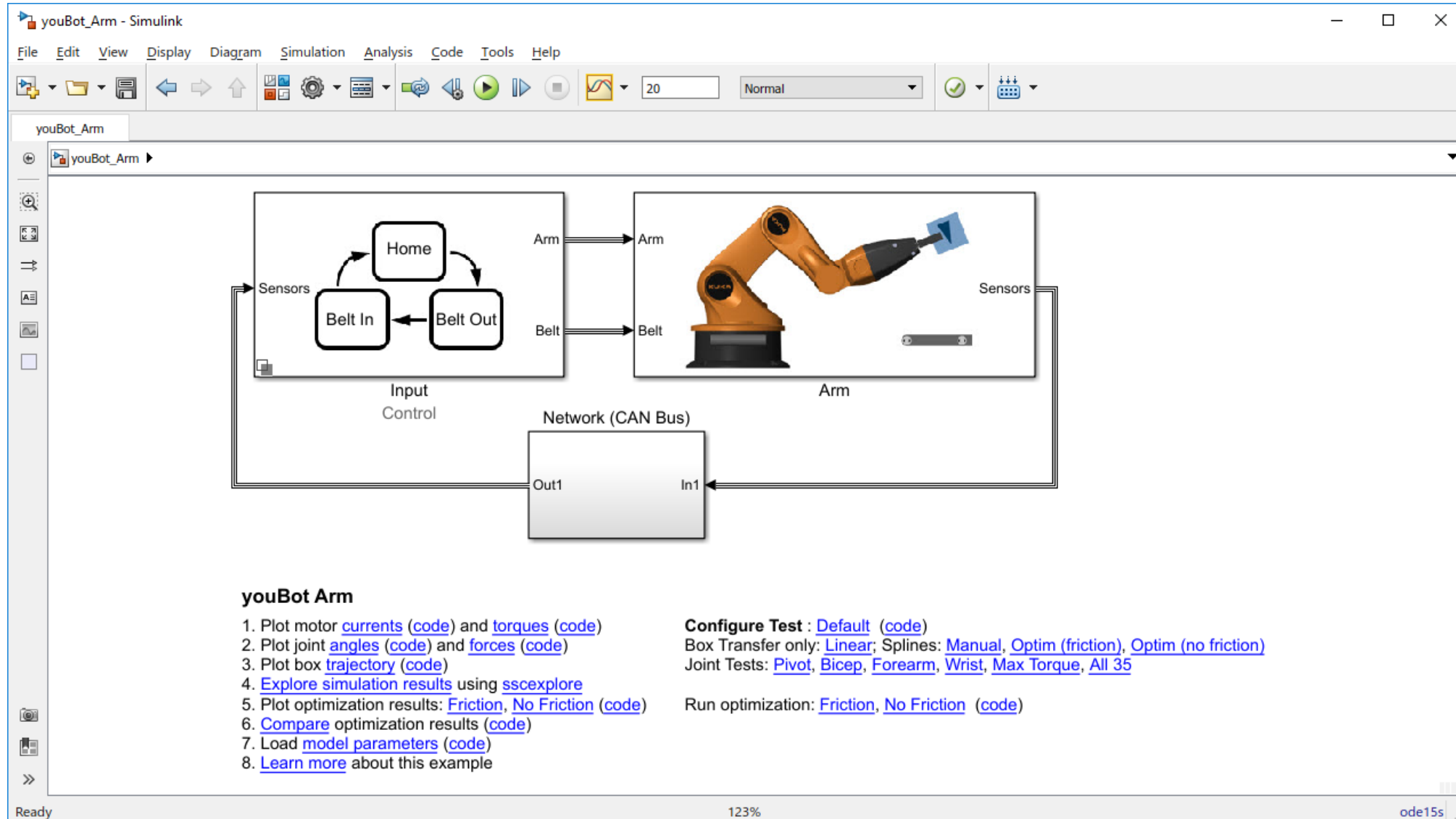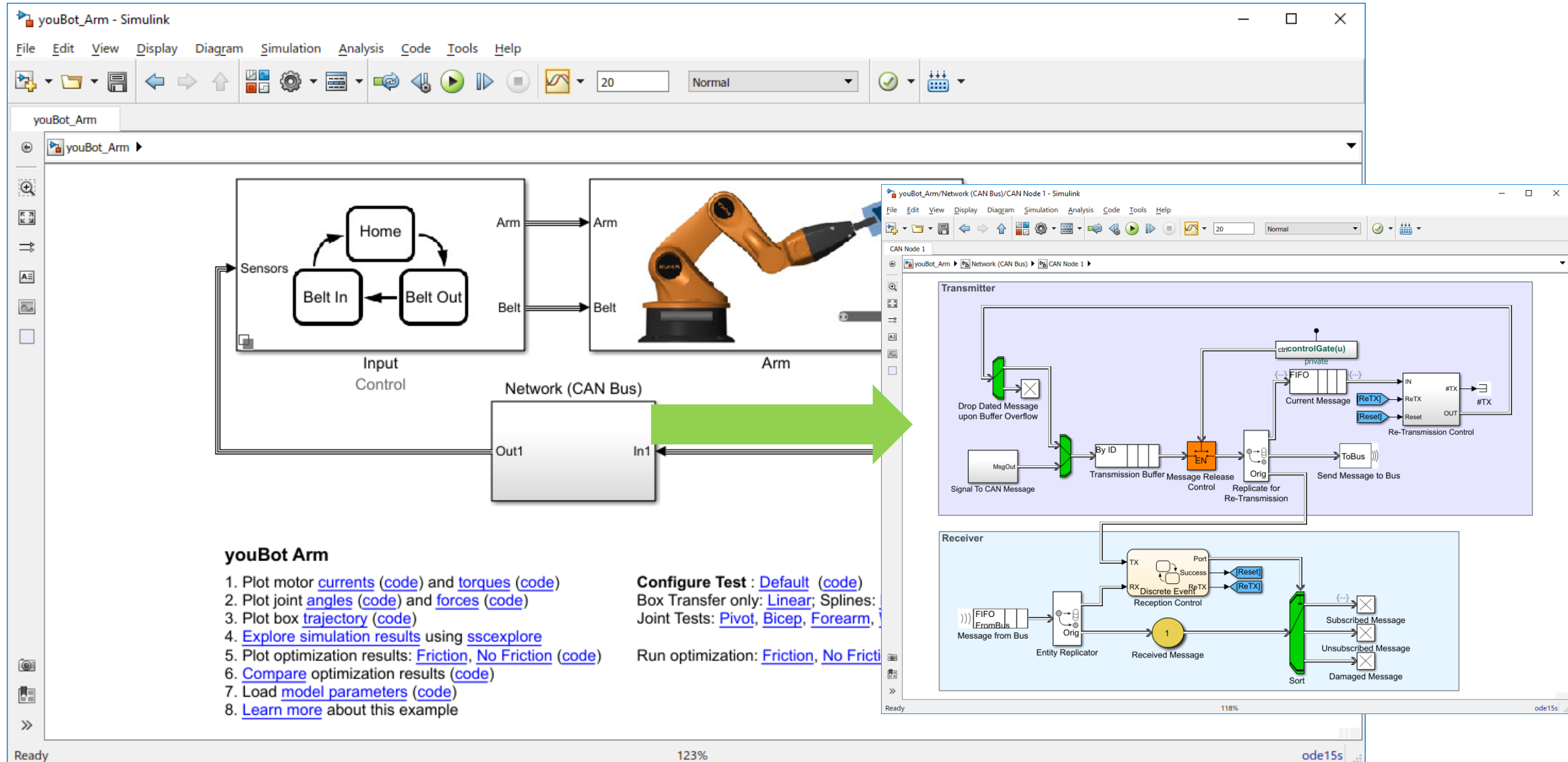# Multi-Domain Model

State Charts and System Dynamics

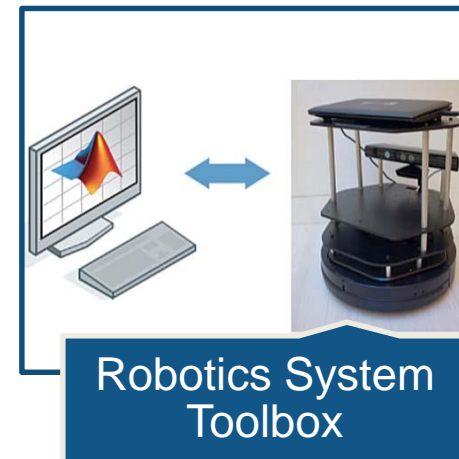# Multi-Domain Model

Physical Modeling
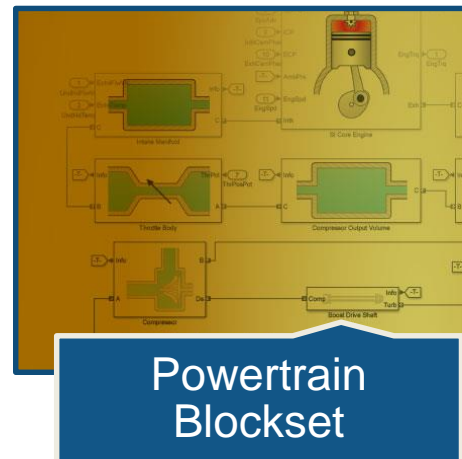
Multi-Domain Model

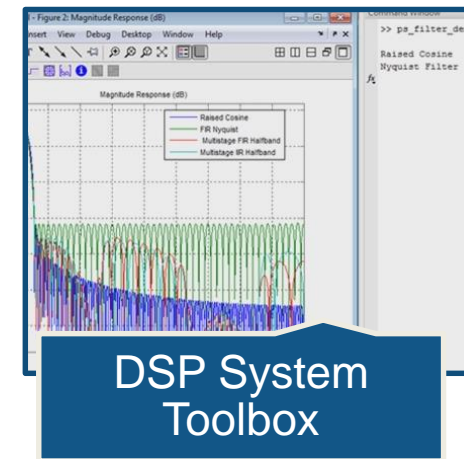# Discrete-Event Modeling

Domain-Specific Blocksets and Toolboxes

- Simulink has numerous domain-specific tools, for example:

Aerospace Blockset

Computer Vision System Toolbox

DSP System Toolbox

Powertrain Blockset

Robotics System Toolbox
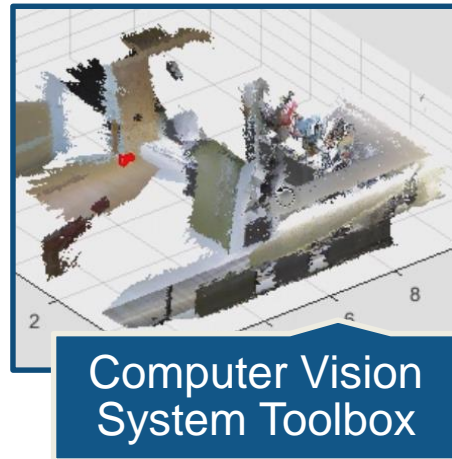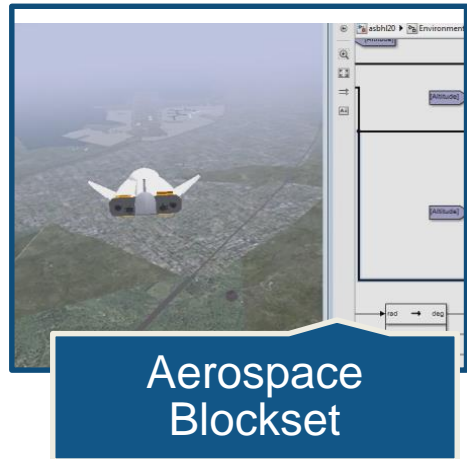
Customer Success in Multidomain Modeling

ABB, Deltamarin, and VTT Simulate and Optimize Ship Energy Flows

Challenge
- Increase the energy efficiency of large vessels

Solution
- Use Simulink and Simscape to model, simulate, and optimize ship energy flow

Results
- Cost- and fuel-saving design improvements
- Testing costs reduced by tens of thousands of euros

Customer Success in Multidomain Modeling

> "Simulink and Simscape enabled us to create a dynamic model of a complex energy system that spans several physical domains. By simulating this model, we can see how a new energy subsystem will perform before it is built, and provide customers with an accurate estimate of their return on investment."
>
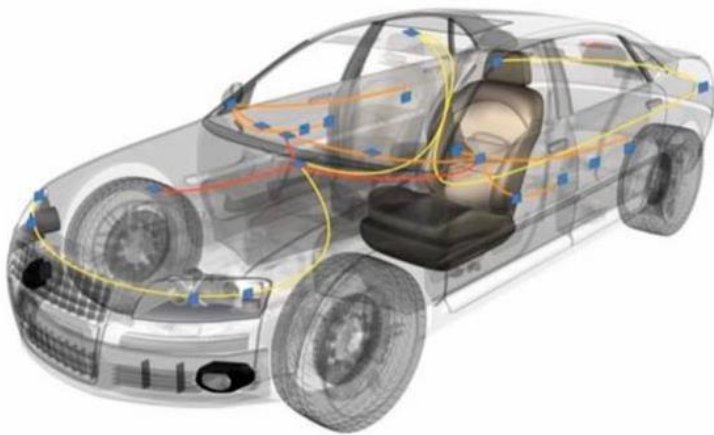> **Juha Orivuori, ABB**

Solution

- Use Simulink and Simscape to model, simulate, and optimize ship energy flow
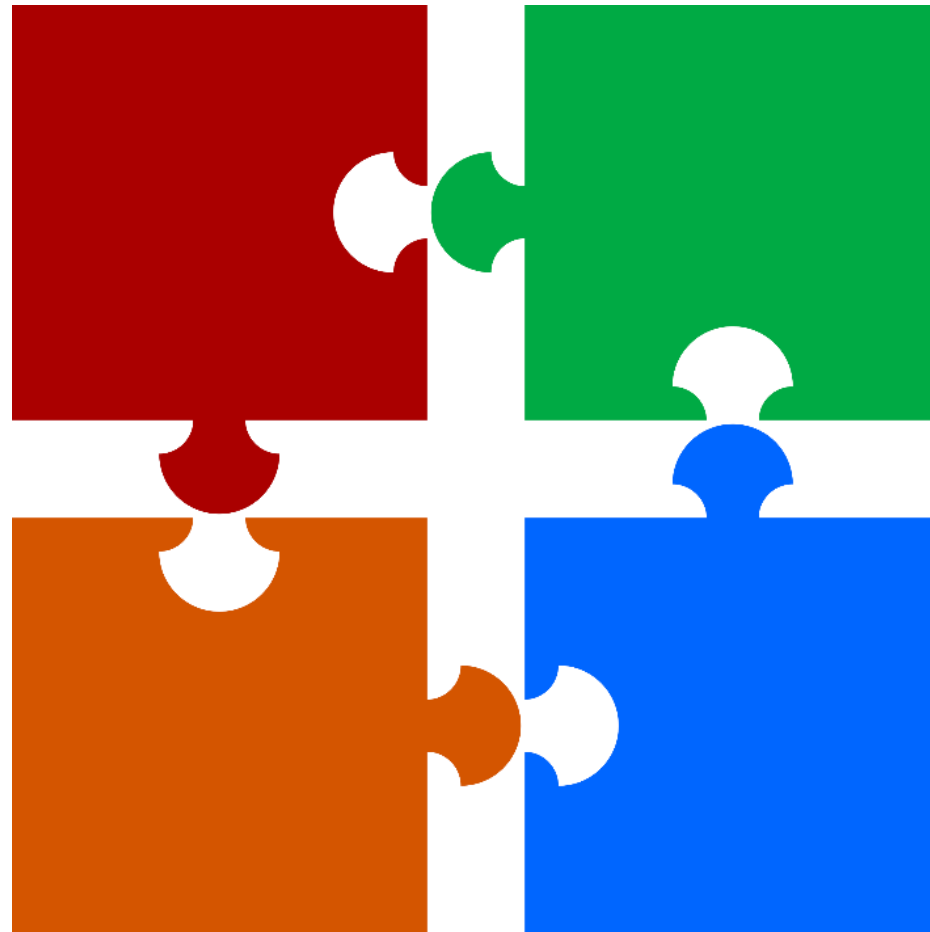
Results

- Cost- and fuel-saving design improvements
- Testing costs reduced by tens of thousands of euros
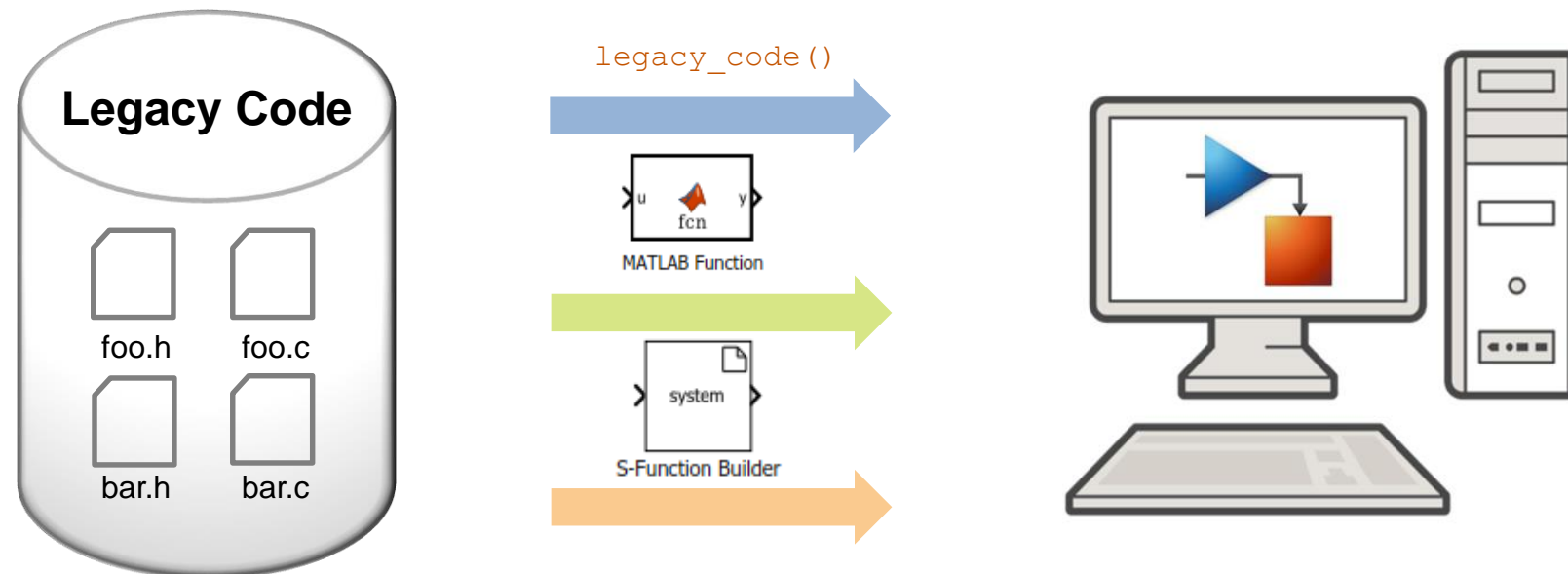
Simulation Integration

Disconnected Component Intellectual Property (IP)

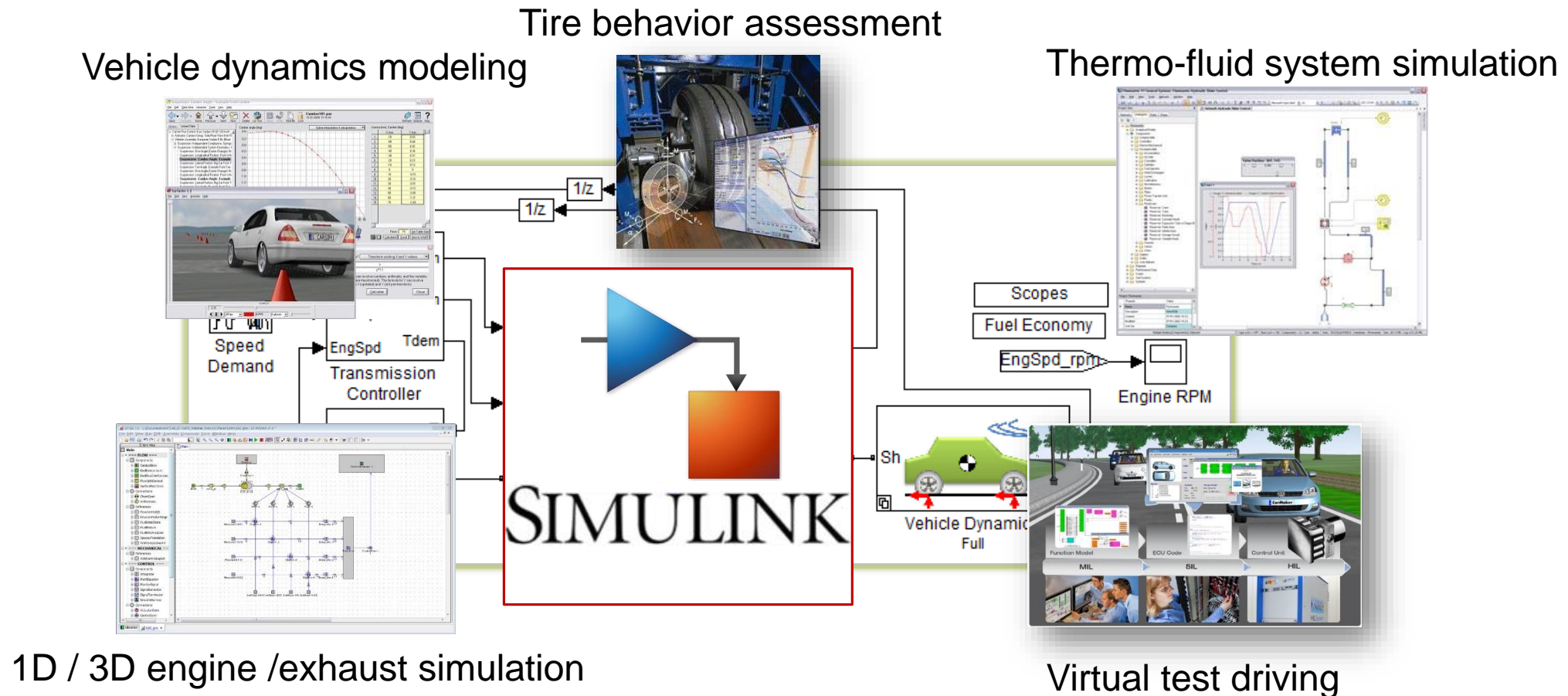- Your IP exists in many forms and in many locations, making integration difficult

Integrating Your Code

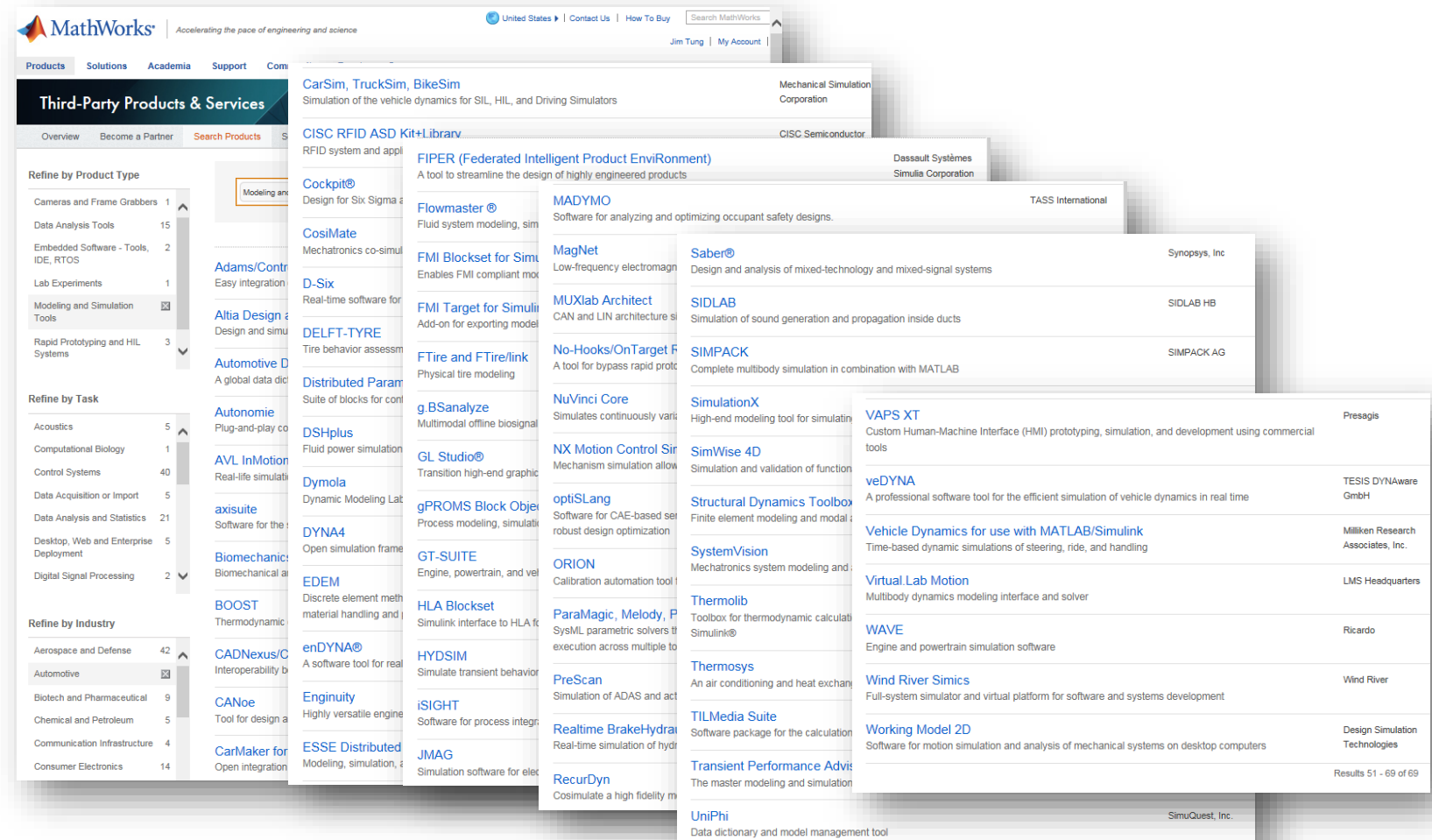- Multiple ways to reuse your legacy code with Simulink

Integrating Third-Party Simulation Tools

Mature and extensive APIs for third-party tool integration

Tire behavior assessment

Vehicle dynamics modeling

Thermo-fluid system simulation

1D / 3D engine /exhaust simulation

Virtual test driving

Partner Ecosystem

- Numerous partners provide interface to Simulink

Customer Success in Simulation Integration

Develop Integrated Vehicle Safety Applications

Siddharth D'Silva, Principal Engineer

Autoliv

Challenge

- Design and validate safety-critical algorithms before implementation

Solution

- Leverage Simulink as a platform by integrating third-party software

Customer Success in Simulation Integration

> "Seamless integration with third party software solutions enables rigorous development in a safe environment. For application engineers or system engineers, it is very useful that you can export these complex third-party tool functionalities in the form of S-functions and run co-simulation."
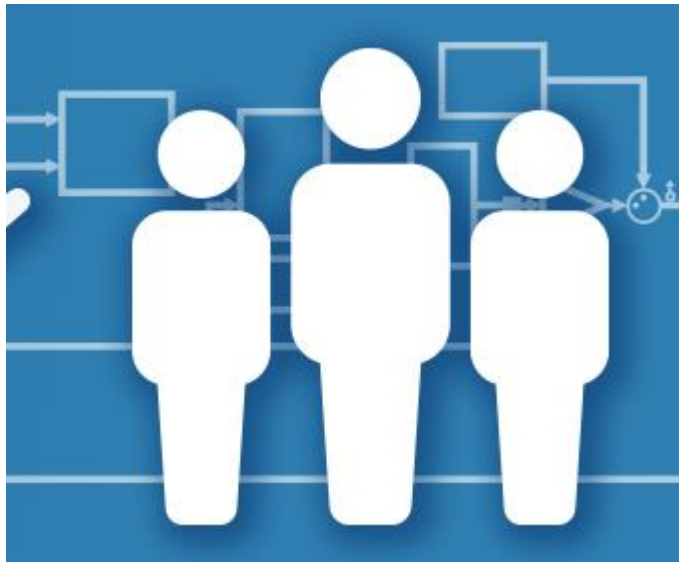>
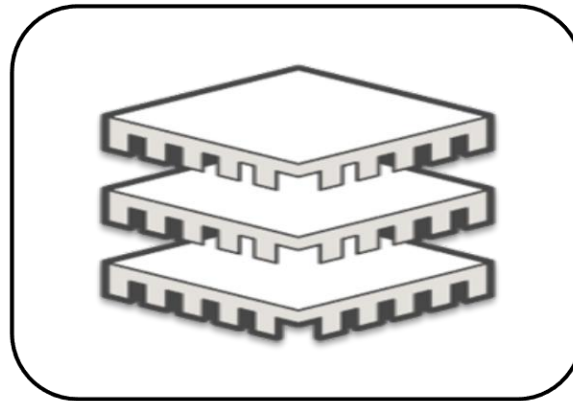> **Siddharth D'Silva, Autoliv**

Results

- Industry first integration of stability control inertial sensor into airbag control unit
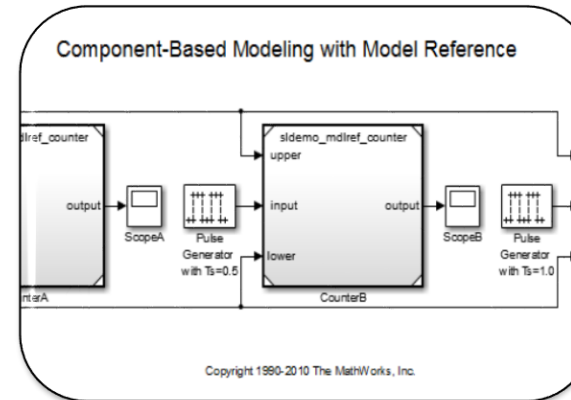- Restraint control module software development time reduced by 30%

Scalability
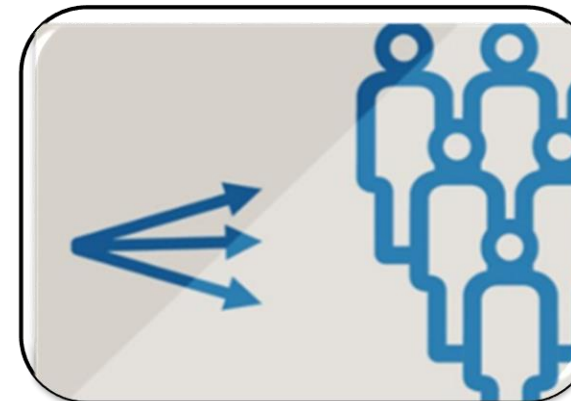
Scalability Challenges
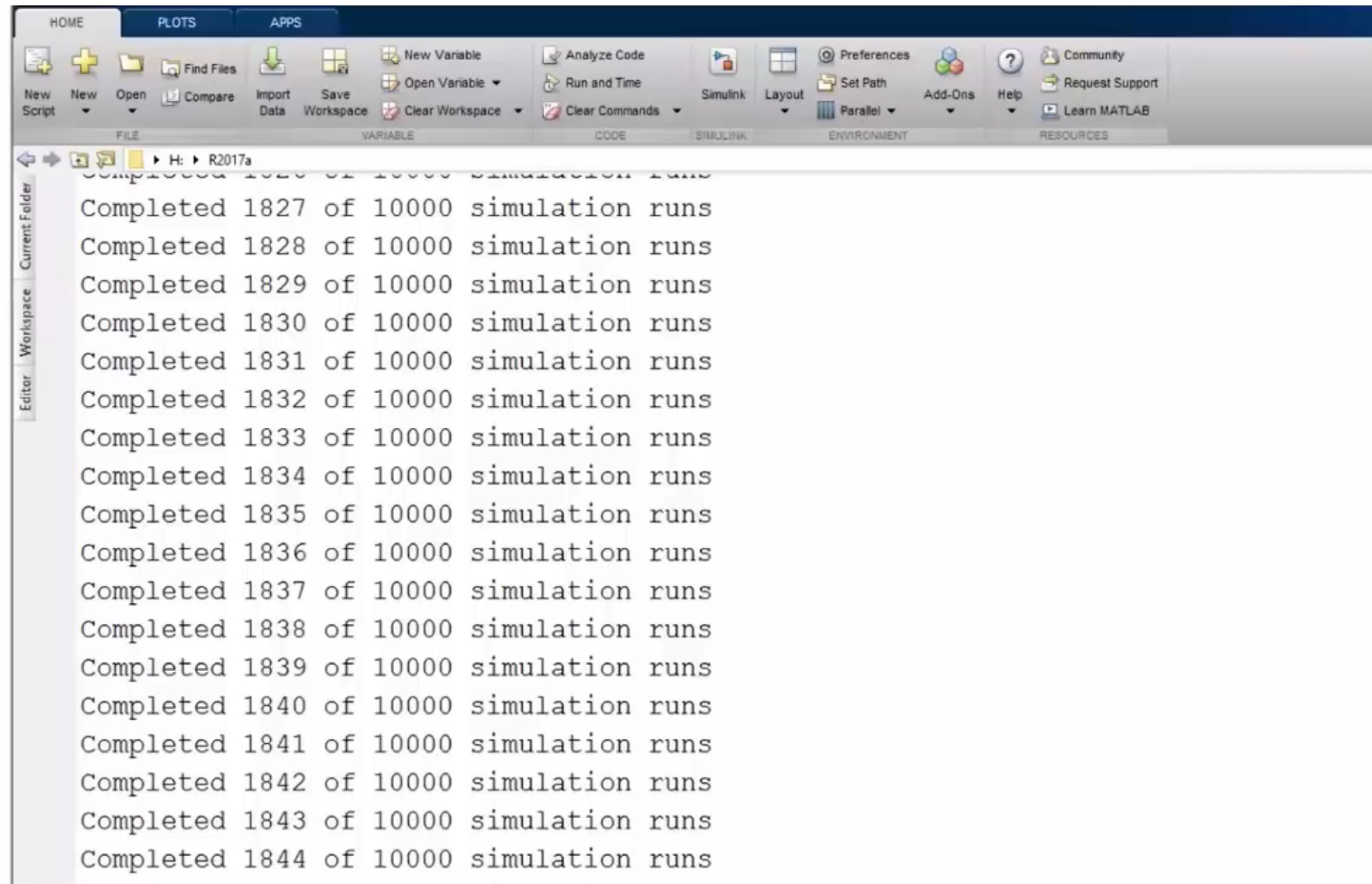
Performance

Componentization
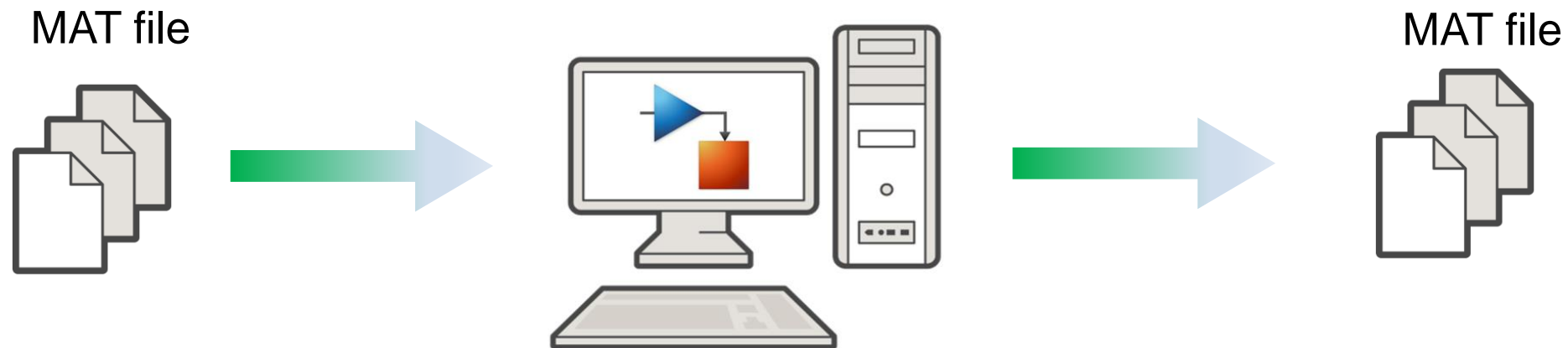
Team Workflows

Sharing

Performance Scalability

- Easy scalability to multicore or cluster/cloud computation environment

Performance Scalability

- Big data workflow
  - Processing large amount of simulation inputs / outputs

MAT file   MAT file

Complex Design Development through Componentization

- Supporting team workflows
  - Faster modular development
  - More effective verification
  - Increased reusability

- Improving performance
  - Incremental loading and code generation
  - Simulation speed
  - Memory usage

Componentization
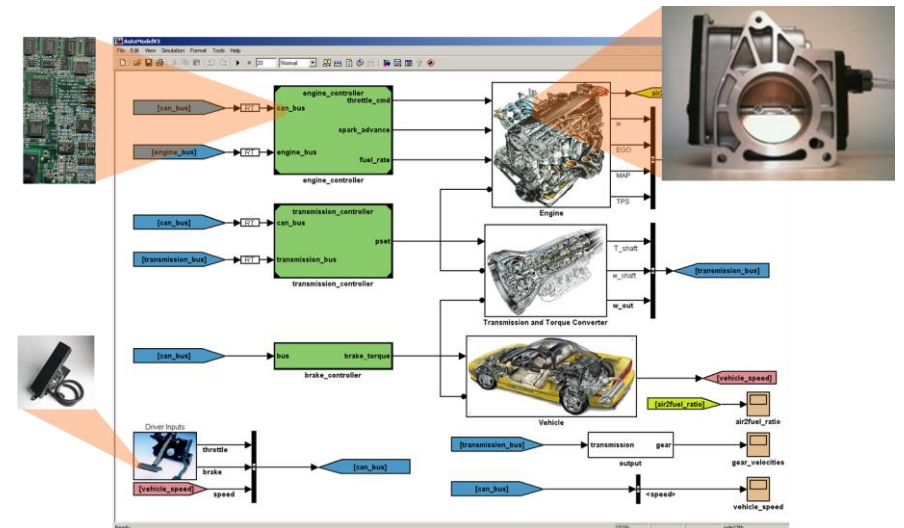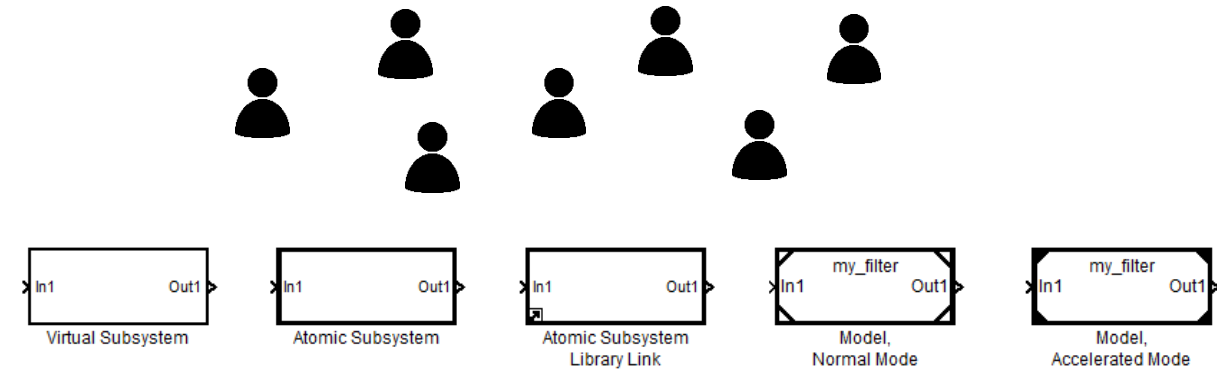
Capabilities Enabling Team Workflows

- Source control
- Design comparison and merging
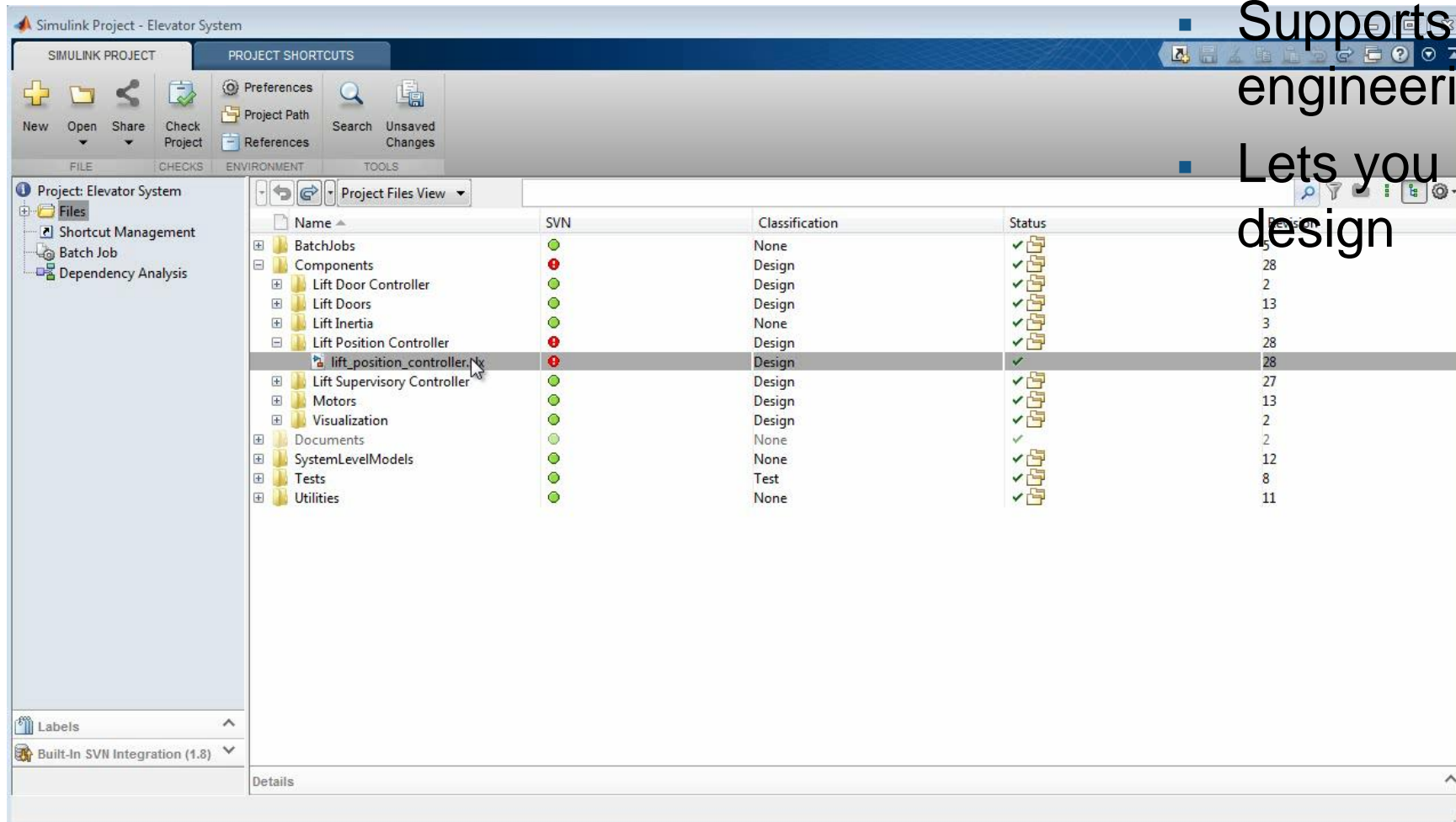- Dependency analysis
- Task automation
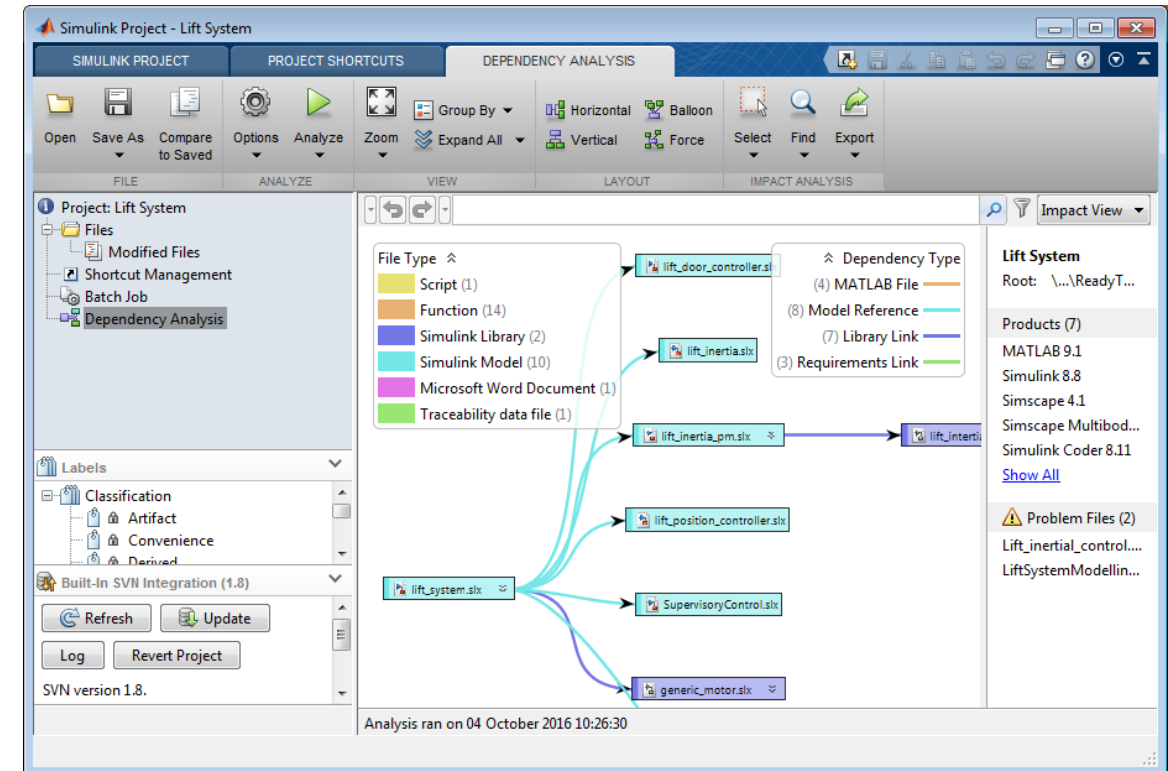
Source Control Integrations

- Microsoft Team Foundation Server (TFS) integration available now from MathWorks File Exchange

Integrating Work from Different Engineers via Merge

- Supports concurrent engineering
- Lets you concentrate on design

Team Workflows

Dependency Analysis – Modular Development

Dependency Analysis – Modular Development

Team Workflows

Task Automation – Configuring Project Environment
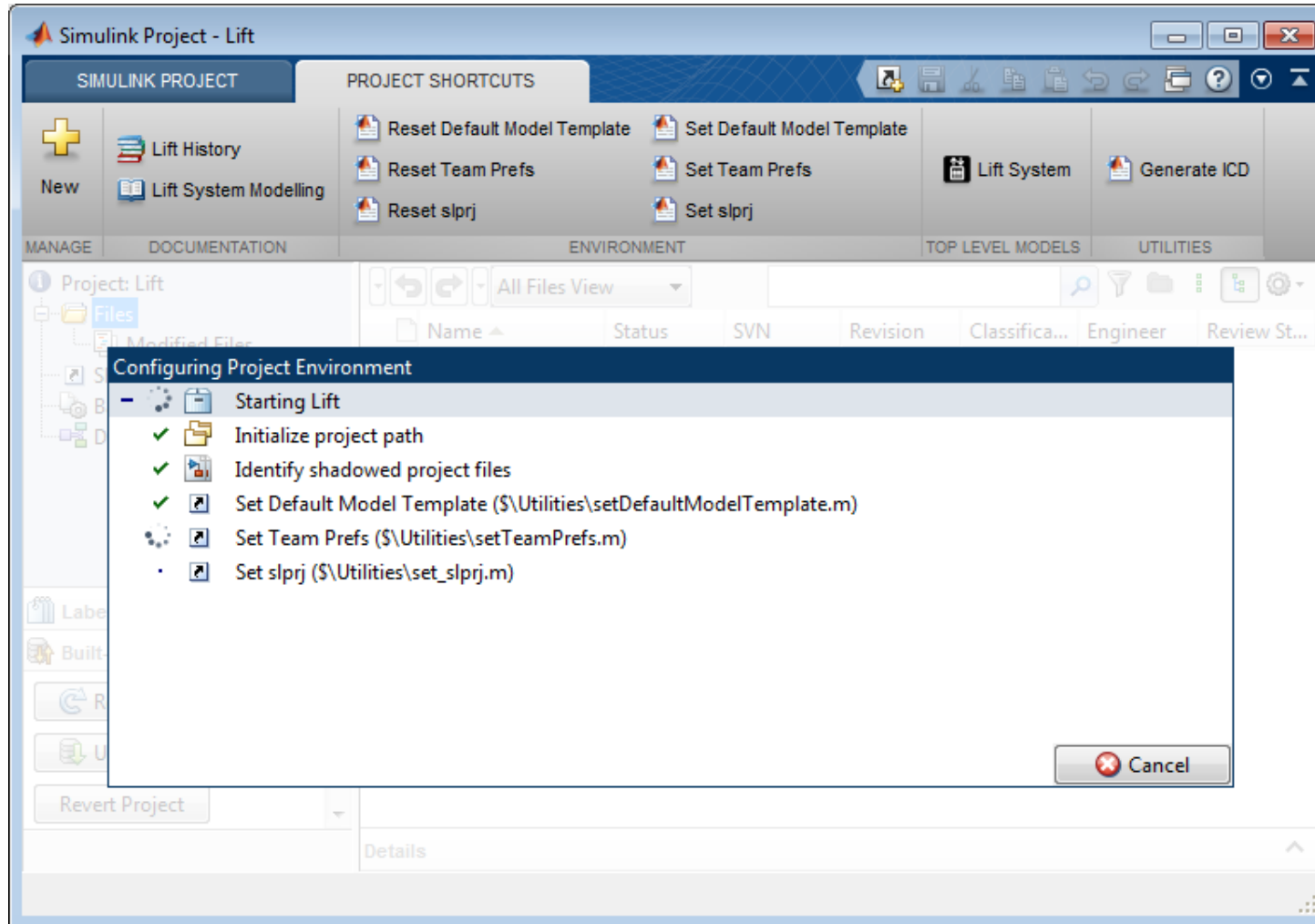
- Robustly configure the team environment

- For everyone

- Automatically

Team Workflows
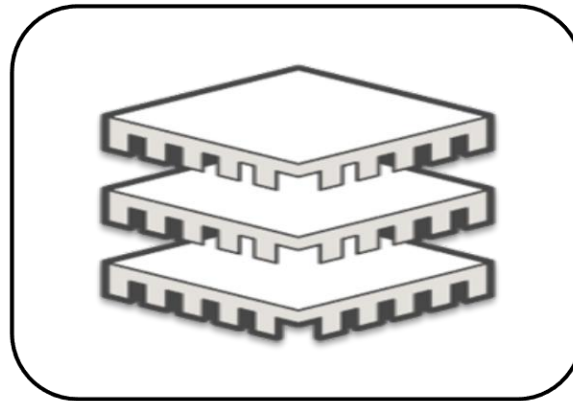
Sharing Outside Your Team

Quick File Packaging

Model Protection (IP Management)
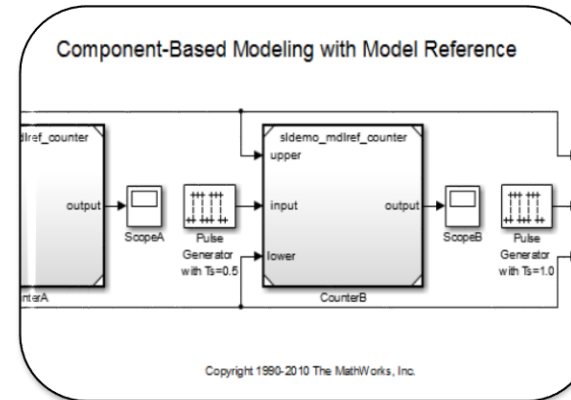
Reporting and Documentation
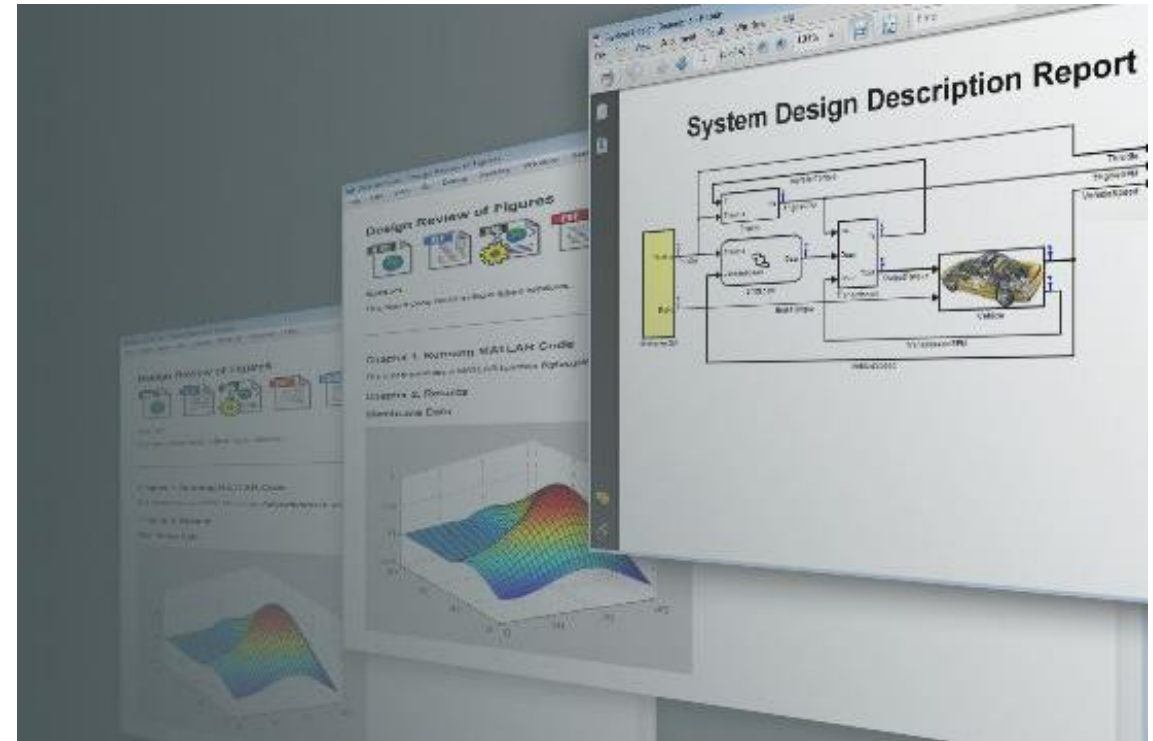
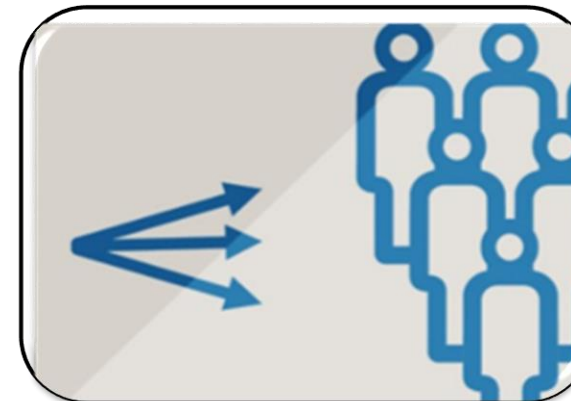# Simulink Addressing Scalability Challenges

Performance

Componentization

Team Workflows

Sharing

Simulink as Enterprise Simulation Platform

*"There is no such tool, which gives the simulation environment as well as the hardware verification and validation. In a single environment, I am getting these together. **That is why I use MATLAB and Simulink.**"*

Dr. Deepak Mishra,
Indian Space Research Organization

Multi-Domain Modeling

Integration

Scalability